Tanta University
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Electrical Power and Machines Engineering Department

Dynamic Performance of Electrical Machines Course
2016/2017

Sheet (1) …… Steady State Performance of D.C. Machines

1 The parameters of a dc shunt machine are $R_f = 240\,\Omega$, $L_{FF} = 120\,\text{H}$, $L_{AF} = 1.8\,\text{H}$, $r_a = 0.6\,\Omega$, $L_{AA} = 0$. The load torque is 5 N·m and $V_a = V_f = 240\,\text{V}$. Calculate the steady-state rotor speed.

2 The power input to a dc shunt motor during rated-load conditions is 100 W. The rotor speed is 2000 r/min and the armature voltage is 100 V. The armature resistance is $2\,\Omega$ and $R_f = 200\,\Omega$. Calculate the no-load rotor speed.

3 A permanent-magnet dc motor has the following parameters: $r_a = 8\,\Omega$ and $k_v = 0.01\ \text{V}\cdot\text{s/rad}$. The shaft load torque is approximated as $T_L = K\omega_r$, where $K = 5 \times 10^{-6}\ \text{N}\cdot\text{m}\cdot\text{s}$. The applied voltage is 6 V and $B_m = 0$. Calculate the steady-state rotor speed ω_r in rad/s.

4 A 250-V 600-r/min 200-hp dc shunt motor is delivering rated horsepower at rated speed. $R_f = 12\,\Omega$, $L_{AF} = 0.18\,\text{H}$, and $r_a = 0.012\,\Omega$.
(*a*) Calculate the terminal voltage that must be applied to this machine to satisfy this load condition.
(*b*) Calculate the full-load ohmic losses and determine the efficiency.

5 The parameters of a dc shunt machine are $r_a = 10\,\Omega$, $R_f = 50\,\Omega$, and $L_{AF} = 0.5\,\text{H}$. Neglect B_m and $V_a = V_f = 25\,\text{V}$. Calculate (*a*) the steady-state stall torque, (*b*) the no-load speed, and (*c*) the steady-state rotor speed with $T_L = 3.75 \times 10^{-3}\omega_r$.

6 A permanent-magnet dc motor is driven by a mechanical source at 3820 r/min. The measured open-circuit armature voltage is 7 V. The mechanical source is disconnected, and a 12-V electric source is connected to the armature. With zero load torque, $I_a = 0.1$ A and $\omega_r = 650$ rad/s. Calculate k_v, B_m, and r_a.

7 Express the maximum steady-state power output of a dc shunt motor ($P_{\text{out}} = T_e\omega_r$) if the field current i_f and armature voltage v_a are held constant. Let $B_m = 0$. (*Hint:* First express the rotor speed for maximum power output.)

8 The parameters of a 5-hp dc shunt machine are $r_a = 0.6\,\Omega$, $L_{AA} = 0.012\,\text{H}$, $R_f = 120\,\Omega$, $L_{FF} = 120\,\text{H}$, $L_{AF} = 1.8\,\text{H}$, and $V_a = V_f = 240\,\text{V}$. Calculate the steady-state rotor speed ω_r for $I_t = 0$.

Parameters for 2 coils

V1=20;

R1=5;

R2=2;

L1=20e-3;

L2=50e-3;

Lm=18e-3;

V2=10;

Parameters for DC Motor [Constant Excitation]

kf=1.05;

Ra=0.5;

La=0;

B=0;

J=2.5;

Va=220;

Load torque is constant.

Required: ia(t),w(t)